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MOVING LAB How one scientist cycled their way through a PhD **p.554**

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COLUMN

What not to do in graduate school

Six limiting maxims PhD students should avoid, from **Buddini Karawdeniya**.

During my time as a graduate student researching analytical sensors in the Dwyer laboratory at The University of Rhode Island in South Kingstown, I made a lot of mistakes — some of which matured into valuable lessons. If you are already in graduate school, or have decided to start, here are six things I recommend you do not do.

SIX TIPS

Compare yourself with others. I've met many scientists who spiral into stress and disappointment because they compare themselves unfavourably with others. Every research field, project and graduate student is unique. In some fields, it can take years to find a breakthrough worth publishing; in others, it's easier to publish frequently. I became worried by the third year of my PhD, when it seemed as if it was taking me longer than others to publish my research project. It took me almost six years to complete my PhD, but my hard work paid off when I published a piece on my flagship project in *Nature Communications*, alongside almost a dozen other publications and two patent applications from various other projects. Instead of looking at what others are doing, learn to be introspective. Grow from your mistakes, and find more efficient and effective work tactics.

Blindly trust your data. I have learnt to be suspicious of my data. Consider what could go wrong when obtaining them — if something seems weird or wrong in some way, it probably is. I was once designing a sensor that would detect minuscule amounts of chemicals with a laser. One day, thrillingly, the signal looked fabulous: the laser power was turned all the way to the highest setting instead of my usual setting; and the higher the laser power, the higher the signal. Although it looked great, it turned out that the equipment was enormously overestimating the sensing performance and was therefore producing useless data. Be aware of issues such as sample contamination, labelling errors or faulty instrument calibrations. Just because you yourself obtained the data, do not blindly trust them.

Suffer alone. Graduate school is no easy gig. Failure is regular and often stings. Seek help and advice from those with more experience, such as senior colleagues, postdocs or your adviser. I've struggled with problems that I could see no way out of. For example, when I switched suppliers for a naturally derived ▶

polysaccharide, I witnessed unexpected results. I was lost after days of measurements: how could the same polysaccharide give me different signals? When I approached my adviser, he suggested a technique I hadn't considered, and it helped me to uncover a difference in the composition of the polysaccharides that was behind the inconsistent signals.

Believe that more work is always better. We all get excited about where our latest data are taking us, and it's not uncommon to work a few night shifts or weekends to get all of the data you need. Once, a colleague and I were unable to determine whether our nanosensor was working correctly, even after we had desperately tried many instrumental methods. In despair, we temporarily abandoned the mission and took a break. Rest brought clarity: after our break, we had the energy we needed to find an alternative solution to our problem. When working on something non-stop for long periods of time, we can develop tunnel vision or burn out. Take a break and start afresh when necessary.

Your records should grow organically. Like most graduate students, I kept records in lab notebooks. This works for a few days, but not for an entire PhD project (especially when you are expected to handle multiple projects simultaneously). Keep clear records and maintain Excel sheets or Word documents with experimental logs. Build an appendix with links to the folders in which you've saved data, analysis and figures that you're about to publish. By the time I completed my PhD, I had 19 lab notebooks, and I would have been doomed without the help of Excel files, appendices and indexes. Find ways to protect and keep track of your data from the beginning — don't wait for a haystack to form around your needle.

Get stuck after one failure. It's not easy to ditch a theory or an experiment you worked hard on. But knowing when to change direction is pivotal to success during a PhD. The first project I worked on as a graduate student was unsuccessful, despite 18 months of devotion. After this perceived failure, I was starting to feel disappointed. One day after a great discussion with my adviser, I moved on to a different project. After I worked out how to 'fail fast', I was able to dedicate my time to projects that brought me great success and eventually led to several interesting publications, research awards and fellowships. ■

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COLUMN

Biking through my PhD

Overcoming my struggles after leaving China for my PhD has been like riding a bike, says **Shuxuan Zheng**.

BY SHUXUAN ZHENG

Having flown halfway around the world, I finally arrived in the Netherlands to start work on my PhD at the medical microbiology department of University Medical Center Utrecht.

I was delighted to think of all the things I would see and experience in this new and different world. That was until I saw the one thing that absolutely terrified me — a bicycle.

I had never learnt to ride a bike. Growing up in Qingdao, a hilly, seaside city in China without cycle paths, biking was dangerous. The local laws discourage it for safety reasons. Now, my Dutch neighbour was telling me I had to learn. She sold me a second-hand bike and pointed me to the car park. I upgraded my insurance and started practising.

It took me a week to learn, and a month to feel comfortable cycling. Now, after half a year, I am starting to enjoy it. For me, a helpful trick for dealing with Dutch traffic was to make a lot of noise as I rode: squawks, loud laughs, "look out", "watch it", and so on. This frightened other cyclists into keeping away from me, and prevented the crashes that had seemed inevitable when I started.

Now I've got used to it, cycling has become a symbol of my growth, freedom and successful adjustment to PhD life in the Netherlands. This pattern, of a time of struggle followed by fun, was repeated with other aspects of my life in Utrecht. There were more 'bikes' that I needed to learn how to ride. One of them was time management.

During my seven years of training in veterinary medicine in China, I got used to the 'Chinese' schedule. We came to work at 8 a.m. and left at around 10 p.m., often working at the weekend. There wasn't much time left for a social life or hobbies, so you made your job your hobby, and your co-workers provided your social life. But in Utrecht, people come to work at 9 a.m. and leave at 6 p.m. — and as for working at the weekend, forget it. How do they get all their work done?

I initially assumed that nobody was working very hard, because of their shorter hours. But after a few months, I realized I was the one not working hard: just because I stayed at work later did not mean I worked harder. In fact, the other PhD students were all completely focused on their work during that eight-hour working period and were super organized, whereas I was taking endless 'breaks'. In reality, I was Facebooking, Instagramming and messing around when I could have been focusing on my studies.

All this time, I'd been struggling with my inefficient and poorly planned working hours, so I finally resolved to 'learn to ride the bike' again and adjusted my routine. After a few months, I found that my revised plan of action was much more efficient: I am now more engaged and productive, and I get to have a life after work for the first time.

Something else happened when I started my PhD — and, like a downhill stretch on a bicycle, it was very welcome. I had gone to an international boarding school when I was six, and I spent most of my childhood in a relaxed and casual environment that gave me the freedom to explore without fear. I enjoyed this time of 'wildness'. But later in life, it became a problem for me — because I was unprepared for the constraints, as I saw them, of formal interactions in the Chinese workplace.

> ***"Now I've got used to it, cycling has become a symbol of my growth, freedom and successful adjustment."***

All that changed on the day I met Robert Jan Lebbink and Emmanuel Wiertz, my PhD supervisors. In the Netherlands, respect is based on your work, not on unnecessarily formal 'civility'. I know that I can just wander into their offices and ask a casual question without worrying about causing offence. This shift has been transformational for me and has made me much more comfortable at work.

Even though most of the changes I have faced were forced on me as a result of my move, I am thankful that they happened. I'm looking forward to the next cycling challenge I encounter. ■

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